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THE ARCTIC INSTITUTE OF NORTH AMERICA

DEVON ISLAND EXPEDITION 1960 - 1963

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Scientific Program

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The Devon Island Scientific Program

Since 1946 the Institute has sent more than 400 small research groups into the Arctic regions. Although reconnaissance and individual studies are still important there is now a need for coordinated intensive studies if basic research is to be materially furthered. Certain key locations need adequate housing and laboratory space associated with continual recording of environmental conditions so that senior scientists can systematically advance their studies in coordinated groups.

Devon Island is one such key area. The Arctic Institute has installed temporary buildings and facilities on the north coast, west of Cape Sparbo and will install a satellite station on the ice-cap a few miles to the south in 1961. These stations will be used for the next three years by the Institute's Devon Island Expedition under the leadership of Spencer Apollonio of Yale University. A group of senior workers from several nations will carry out the program, around the year when necessary.

Because an integrated study requires a focus, the program is oriented toward an understanding of factors affecting marine productivity in an ocean sector adjacent to an ice-cap; but results from the individual parts of the program could be applied equally importantly to many other subjects such as dynamic meteorology, hydrology, plant production, mammal ecology, hydrography, sea-ice physics, etc. Results of combined studies could also help provide an understanding of past conditions and might help with forecasting future conditions, as for example climatic trends affecting fisheries or shipping, The program will offer information relevant to the Ewing-Donn open polar ocean hypothesis, and should lead to an understanding of other basic processes in the polar regions.

The individual studies in the program all have valuable objectives in their own right, but the principal aim of the expedition is to analyse the relationships between the studies in order to provide a more complete understanding of each subject, and to provide a body of knowledge more important than the sum of its components. For example: meteorological, micro-meteorological, and solar radiation observations will help in understanding the climatic factors controlling the present nature of the ice-cap; the meteorological and oceanographic observations will permit a determination of heat and moisture transfer in the cycle-sea to ice-cap, ice-cap back to sea; the solar radiation information will measure the amount of solar energy available for primary hydrobiological photosynthesis; the glaciology will determine the quantities of ice available to affect the biological and chemical oceanography of Jones Sound.

Devon Island is particularly suitable for this station because it provides glaciated, and marine environments within very convenient distances, and a variety of studies can be made from two bases relatively

close together. It is "arctic" by every criterion, lies near the edge of the permanent pack-ice, and yet is still accessible by ship. The island is little known and there are no other occupied sites on it.

The main objectives of the Devon Island project:

1) A study of the relationships between the marine environment, the Devon Island Ice Cap, and the adjacent atmosphere, with special regard to heat budget, energy flow, and moisture transfer.

2) A detailed investigation of the oceanography and marine biology of Jones Sound.

3) A detailed investigation of the archaeology, biology and geology of Devon Island, particularly where such studies provide auxiliary information for objective #1.

THE ARCTIC INSTITUTE DEVON ISLAND SCIENTIFIC PROJECT, 1960-63

The following descriptions of the disciplinary studies are given in order of priority to the project. It is intended that the studies will supplement one another, but there is a priority aimed at understanding the biology and oceanographic environment of Jones Sound. All other studies are related to this, for the purposes of the Devon Island Expedition.

(A) Oceanography

1. Determination of the circulation of Jones Sound by
   (a) Temperature and salinity measurements at various depths on several transects across the Sound.
   (b) Direct current measurements at the mouth of Cardigan Strait and at the eastern end of Jones Sound.
   (c) Observations of ice movement.

2. Determination of ice formation and heat flow in Jones Sound by
   (a) Temperature measurements by electrical-resistance methods
   (b) Regular measurements of ice thickness.

3. Determination of the effects of glaciers on oceanography and marine biology
   (a) Determination of annual amount of ice discharged from several glaciers.
   (b) Determination of possible gradients along radii from glacier fronts of salinity, sedimentation rates, benthonic populations, chemical constituents and biological productivity.
   (c) Investigation of "brown zones".

4. Depth soundings in Jones Sound.

5. Historical oceanography. These studies will only be carried out when possible during the other projects since the historical oceanography is considered as a secondary objective rather than a primary study. It could be done as part of the primary study by collection of bottom cores in order to determine sedimentation rates, and previous predominant temperatures, ice cover and circulation in Jones Sound.

   Personnel: 1 oceanographer (S, Apollonio) and 1 assistant
   with supporting personnel as required.

(B) Biology - Marine and Lake

1. Measurements of annual amount and cycle of primary organic productivity by
    - (a) Carbon 14 isotope methods
    - (b) Oxygen light and dark bottle method
    - (c) Chlorophyll method

2. Measurement of amount and cycle of chlorophyll concentrations.

3. Determinations of subsurface light penetration through snow and ice into water.

4. Measurements of annual standing crops of zooplankton and benthos.

5. Determination of metabolic rates and food requirements of zooplankton under arctic conditions by oxygen measurement.

6. Determinations of concentrations and annual fluctuations of biologically significant chemical parameters.

    - (a) Oxygen
    - (b) Nitrates
    - (c) Phosphates
    - (d) Silicates
    - (e) Iron

7. Nutrient enrichment experiments on phytoplankton growth.

Personnel: 1 oceanographer-hydrobiologist and 1 assistant

(C) Glaciology

1. Determination of the thickness of the Devon Island Ice Cap if deemed significant, and determination of the thickness profiles, of selected valley glaciers, two of which exit into the sea of Jones Sound, and one of which terminates on land in the same general area.

2. Mass balance:

    - (a) Annual accumulation
        - i) By stake measurements
        - ii) By deep pit, annual layer, thickness and density measurements.
    - (b) Annual ablation by stake and density measurements.
    - (c) Loss by ice berg calving from tributary glaciers determined by thickness, lateral movement and aerial measurements. This latter project may be a complex one and it has been suggested that the expedition develop a system of submarine measurement of the glacier front in the sea. Suggested methods to date include a sonar buoy moored at a specific point in front of the glacier, seismic survey, or drilling on the terminus of the glacier in an attempt to find out if there is an overhang in the sea.

3. Heat budget:
   (a) Ice temperature measurements by electrical resistance methods.
   (b) Total incoming short wave and outgoing short and long wave radiation recorded continuously at sea level and at 6,000 feet on the Ice Cap.
   (c) Determination of the influence of humidity, turbulence, **temperature**, cloud cover, etc., as compared with radiation, by micro-meteorological observations at 6,000 feet, and during the ablation period, at a temporary ablation-zone station.

   Personnel: 1 glaciologist and 1 assistant;
   1 seismologist and 1 assistant;
   and supporting personnel as required.

(D) Meteorology

1. Determination of the local climate at sea level and at 6,000 feet on the Ice Cap by regular and frequent observations for two years.
   (a) Surface synoptic observations of wet and dry bulb, maximum and minimum temperatures, humidity, pressure, wind speed and direction, precipitation and cloud cover, every six hours.
   (b) Frequent vertical temperature and humidity observations by WIRESONDE KYTOON observations. Upper air PIBAL observations twice daily may not be made.

2. Micro-meteorological observations of temperature, humidity, wind speed and direction, and in situ ground temperatures at sea level and on the Ice Cap.

3. Continuous solar and sky radiation and albedo recordings.

4. A determination of ablation and evaporation during the melt period in the ablation zone of the Ice Cap, from a temporary station.

Important secondary objectives of the Devon Island Project

(A) Meteorology

1. An understanding of the regional climate.
2. Development of a sound technique and instrumentation for assessing the turbulent transfer of heat at the earth's surface.

(B) Glaciology

1. An understanding of the movement of the Devon Island ice-cap.
2. Development of techniques for rapid assessment of ice quantities and movement.
3. An understanding of the role of glaciers in providing nutrients for marine life.

(C) Geology

1. The general geology of the island.
2. An understanding of the chemical contribution of the rocks to the oceans.

(D) Archaeology

1. A history of occupation of the island.
2. The possible role of the island in diverting migrations of people in the past.
3. Establishment of previous marine environments, shore line migration etc., from the archaeological record.

(E) Photogrammetry

1. Preparation of maps of the ice-cap and adjacent regions, with special emphasis on glacier budget and movement studies by aerial phtographic methods over a long time period.

(F) Geography

Preparation of terrain maps of all types. Vegetation maps, historical maps by ground work and photo- interpretation.

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